soft x-ray radiation of laser-produced plasma of various target materials [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.107

1Kologrivov A.A., 1Rupasov A.A., 1Bolkhovitinov E.A., 2Stuchebrukhov I.A., 2Abrosimov S.A., 1Shelkovenko T.A.

1P.N. Lebedev Physical Institute of RAS, Moscow, Russia  
2A.M. Prokhorov General Physics Institute of RAS, Moscow, Russia

Studies of soft X-ray radiation spectra of laser-produced plasma in a wide spectral range (5-100 Å) were carried out jointly by LPI of RAS and GPI of RAS on “Kamerton-T” laser facility [1]. Radiation at the wavelength of the second harmonic of the Nd-laser (0.53 m) at a pulse duration of ~ 70 ps with an energy of ~ 1-5 J was focused on flat solid targets made of various materials - Al, Si, Ti, Cu, Ta and W. At these conditions, the power flux density was 7x1014 – 3.5x1015 W/cm2. The spectrograph with a transmission diffraction grating with an elementary gap to structure period ratio of 0.41 was used. The recording of laser plasma spectra was carried out on Fuji TR fluorescent imaging plate.

The ionization states of the plasma corresponding to various electron temperatures were calculated, which made it possible to estimate the electron temperature by comparison of these calculation results with the experimentally obtained spectra. The estimated electron temperature, which depends on the laser power flux density and the target material, varied within the range 100–450 eV. To verify the correctness of the temperature estimations obtained by such comparison a numerical simulation of plasma radiation was carried out by the use of PrismSPECT computer program [2]. It was found that the results of this simulation are in good agreement with estimations on the base of experimentally obtained spectra. The analysis of these spectra showed that tungsten, tantalum or titanium targets are the best candidates among the tested ones for the use of laser-produced plasma as a radiation source in the “water window” spectral range (23–44 Å) for applications in biology and medicine.

Reference

1. Kologrivov A.A., Rupasov A.A., Bolkhovitinov E.A., Stuchebrukhov I.A., Abrosimov S.A., Shelkovenko T.A., Spectral studies of soft x-ray radiation of laser-produced plasma of various target materials in a wide spectral range. Phys. Rev. E, 2022, v. 106 B, 045205. DOI: 10.1103/PhysRevE.106.045205
2. MacFarlane J.J., Golovkin I.E., Wang P., Woodruff P.R., Pereyra N.A., SPECT3D - A multi-dimensional collisional-radiative code for generating diagnostic signatures based on hydrodynamics and PIC simulation output, High Energy Density Phys. 2007, v.3, p.181.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/It/ru/DL-Kologrivov.docx) [↑](#footnote-ref-1)